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REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN ADDENDUM

BERRY'S CREEK STUDY AREA

Submitted to

U.S. Environmental Protection Agency

Submitted by

Berry's Creek Study Area Cooperating PRP Group

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Report Contributors

This Remedial Investigation/Feasibility Study Work Plan Addendum was prepared by Geosyntec Consultants (Geosyntec), Integral Consulting Inc. (Integral), The Loper Group, Inc. and The ELM Group (ELM). The Technical Committee of the Berry's Creek Study Area Cooperating PRP Group also provided input and contributed to the document preparation.

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LIST OF ACRONYMS

AOC	administrative order on consent
BAZ	biologically active zone
BCC	Berry's Creek Canal
BCSA	Berry's Creek Study Area

BERA	baseline ecological risk assessment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	chemical of potential concern
CSM	conceptual site model
DO	dissolved oxygen
DOC	dissolved organic carbon
DMP	data management plan
DQO	data quality objective
EPA	United States Environmental Protection Agency
ERTG	East Riser Tide Gate
ERA	ecological risk assessment
FS	feasibility study
FSP	field sampling plan
LBC	Lower Berry's Creek
MBC	Middle Berry's Creek
NJDEP	New Jersey Department of Environmental Protection
NJSEA	New Jersey Sports and Exposition Authority
PIC	Peach Island Creek
POC	particulate organic carbon
PRP	potentially responsible party
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
SOP	standard operating procedure
SOW	statement of work
SVOC	semivolatile organic compound
TAL	target analyte list
TOC	total organic carbon
TSS	total suspended solids
UBC	Upper Berry's Creek
UPIC	Upper Peach Island Creek
WP	work plan
WRTG	West Riser Tide Gate

Note: Tables and figures may have additional acronyms and abbreviations.

SECTION 1

INTRODUCTION AND BACKGROUND

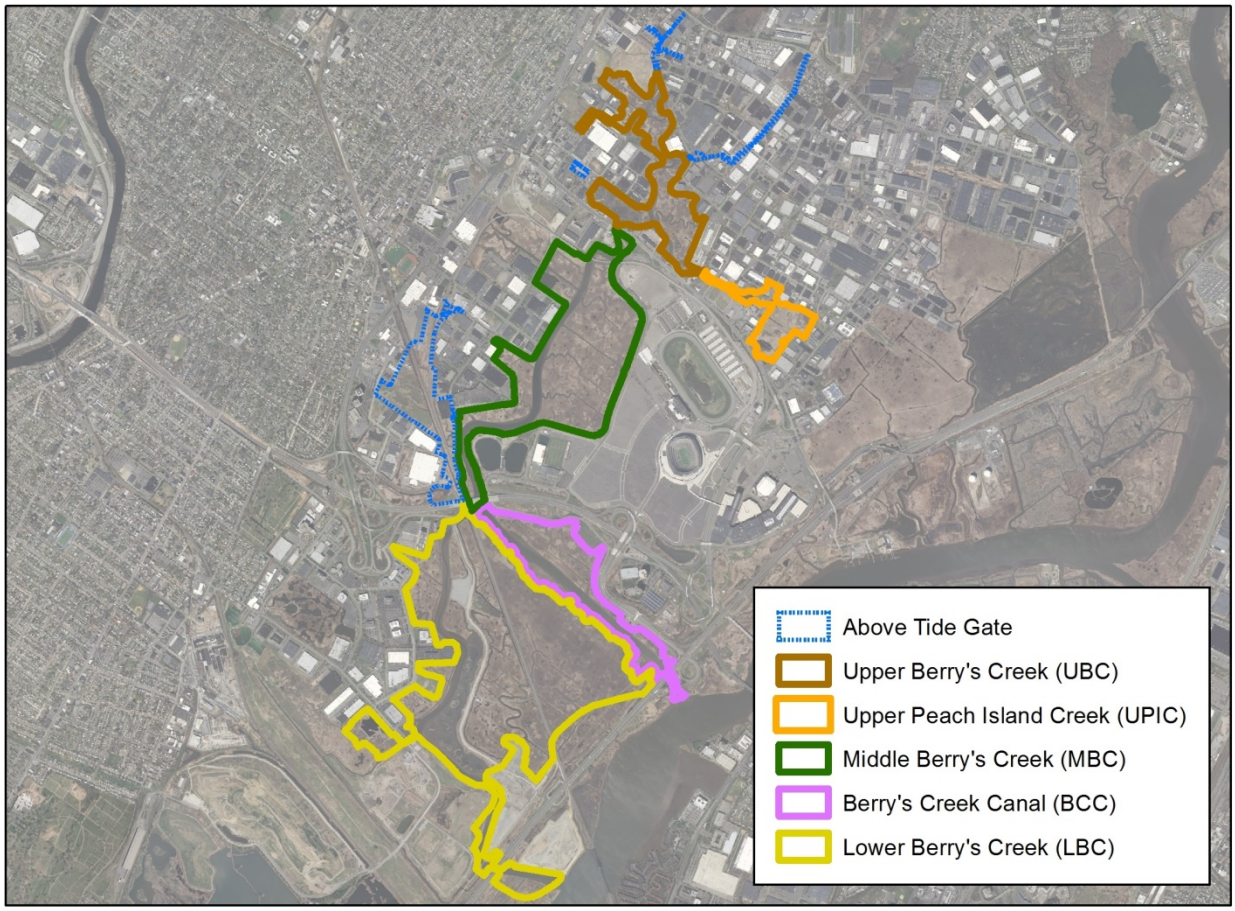
1.1 Introduction

This Remedial Investigation/Feasibility Study (RI/FS) Work Plan Addendum is being submitted by the Berry's Creek Study Area (BCSA, or the site) Cooperating Potentially Responsible Party Group (hereafter referred to as "the BCSA Group") in response to a June 13, 2016 letter request from Carole Petersen, Chief, New Jersey Remediation Branch, of the U.S. Environmental Protection Agency (EPA) to Peter Brussock, Project Coordinator for the BCSA Group. The addendum updates the FS scope and revises the RI/FS schedule to match the changes to the scope. All work will be completed consistent with the Administrative Order on Consent (AOC) into which the BCSA Group entered in 2008 with the U.S. Environmental Protection Agency (EPA) Region 2.

1.2 Site Setting

The BCSA is an urban watershed located in the Hackensack Meadowlands in Bergen County, New Jersey within one of the most populous and developed regions of North America. The BCSA is defined by the Berry's Creek watershed situated along the middle of the Hackensack River estuary. The watershed consists of approximately 1,029 acres (1.6 mi^2) of tidal waterways and marshes (the "tidal zone") that are the subject of the RI/FS, and 6,670 acres (10.4 mi^2) of highly-urbanized upland areas that drain to the BCSA tidal zone. Commercial and industrial land uses dominate the area directly surrounding the tidal area, while residential land use is largely limited to the uplands above the 100-year flood zone.

Four study segments have been defined for use in discussing the site and are designated: Upper Berry's Creek (UBC), Middle Berry's Creek (MBC), Berry's Creek Canal (BCC), and Lower Berry's Creek (LBC) (Graphic WP Addendum-1). In addition, the area in UBC above the Peach Island Creek tide gate is often referred to as Upper Peach Island Creek (UPIC). Three reference sites were also studied in the RI and were selected based on similar tidal dynamics, vegetation, geology, and salinity: Bellman's Creek and Mill Creek (tributaries to the Hackensack River north and east of the BCSA), and Woodbridge River on the south end of the Arthur Kill.



WP Addendum-1. BCSA Study Segments

1.3 Background

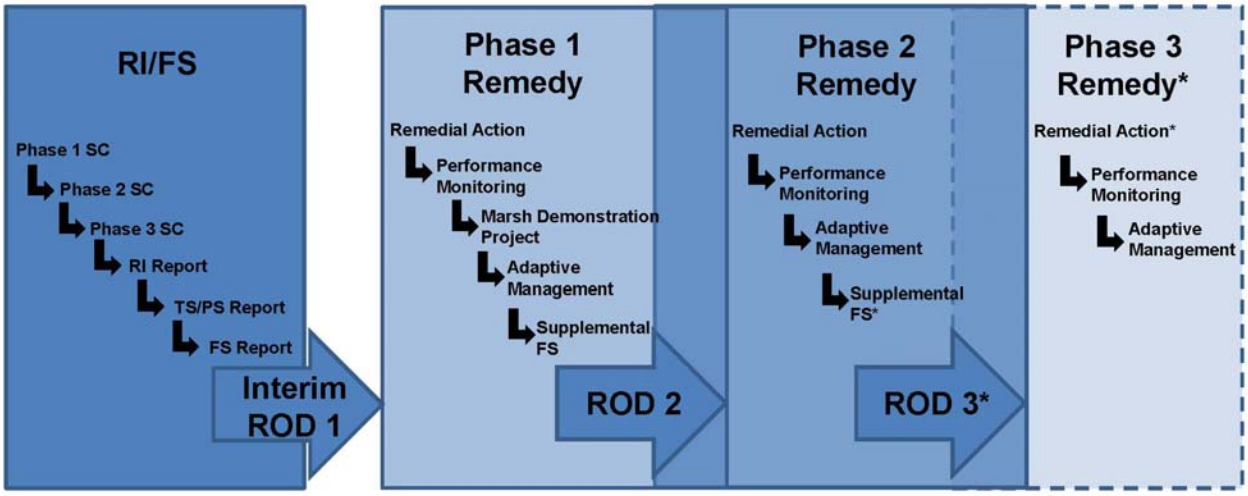
The Statement of Work (SOW) attachment to the AOC requires the BCSA Group to perform a RI/FS pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The purpose of the RI/FS is "to characterize the nature and extent of contamination as provided in this SOW and evaluate remedial alternatives that mitigate potential human health and ecological risks associated with the biouptake and environmental fate and transport of chemicals from historical and on-going sources of hazardous substance releases from various facilities, while taking into account other sources of chemical and non-chemical stressors and relevant background conditions."

Pursuant to the SOW, the BCSA Group developed an RI/FS Work Plan (BCSA Group, 2009) to guide the conduct of the RI and FS. The Work Plan describes in detail the scope and sequence of work activities the BCSA Group would perform in order to complete the RI and FS. Between 2009 and 2016, the BCSA Group conducted a comprehensive multi-phase RI for the BCSA that

culminated in the Group's submittal of a Draft Remedial Investigation Report (RI Report) to EPA in June 2016.

As indicated in EPA's June 13, 2016 letter to the BCSA Group, mercury, methyl mercury, and PCBs have been identified as the primary Chemicals of Concern (COCs) in the BCSA. Certain areas of sediment in the UBC and MBC waterways have much higher COC concentrations and concomitant exposures of receptors than other waterway areas in the BCSA. Contaminants in these locations also may be mobilized to other portions of the BCSA and are contributing to the surface contamination in the marshes. EPA noted that despite extensive studies of the waterways and marshes, there remain uncertainties regarding the mechanisms that drive COC exposures to ecological receptors within the marshes.

Accordingly, as stated in the EPA letter, EPA initiated discussions with the BCSA Group toward developing an iterative approach to remediation, while collecting information to reduce uncertainties associated with other portions of the site. The phased approach envisioned by EPA, including more than one associated decision document, is illustrated below.



* If necessary. SC = Site Characterization; RI = Remedial Investigation; TS/PS = Treatability Study/Pilot Study; FS = Feasibility Study; ROD = Record of Decision

WP Addendum-2. Illustration of RI/FS and Multi-Phase Remedy Process

The first Record of Decision (ROD) for the BCSA will be an interim ROD to implement a "source control"[1] action for the waterways (UBC and MBC) and to address the UPIC Marsh. The interim remedy will substantially reduce further migration of contaminants from source areas and will be a major component of the final remedy for the site. Further actions required for the site, including appropriate remedial actions for the marshes and the final decision for the waterways will be selected in one or more subsequent ROD(s) after conducting remedy effectiveness monitoring. This approach will clean up the areas presenting the greatest risk more expeditiously and the use of adaptive management will help ensure that the overall site remedy will be successful. In addition, consistent with EPA's request, the BCSA Group anticipates that a Marsh Demonstration Project will be implemented during the Phase 1 Remedy. The purpose of this project will be to evaluate the physical, chemical, and/or biological responses of a selected marsh area for the application of one or more marsh remediation technology options on a scale larger than the pilot studies to date, thus reducing uncertainty as to the potential benefits of remedial actions in some marshes following sediment remediation in the waterways.

The June 13, 2016 EPA letter requests that the BCSA Group submit an RI/FS Work Plan Addendum (within 90 calendar days of receipt of the letter) that addresses the Group's plan and proposes a schedule for performing the Phase 1 FS. This document presents the requested addendum and proposed schedule. It describes the scope of a Phase 1 FS that will evaluate remedial alternatives for a contaminated sediment control interim remedial action in the UBC and MBC channel and tributaries. The addendum also describes the scope of an evaluation of alternatives for remediating contaminated surface sediments in UPIC Marsh. This RI/FS Work Plan Addendum incorporates by reference the original 2009 BCSA RI/FS Work Plan and the Amendments thereto.

1.4 Organization of Work Plan Addendum

The remainder of this RI/FS Work Plan Addendum includes the following sections.

- Section 2: Scope of FS Evaluation for Phase 1 Remedial Action - defines the BCSA waterways and marsh areas that will be subject to evaluation in the Phase 1 FS along with a brief description of the basis for including the areas in Phase 1.

[1] Source control in this context refers to the control of surface sediment in waterways containing elevated COC concentrations that can be resuspended during tidal fluctuations and storm events and redistributed to marshes and other BCSA waterways, slowing natural recovery (see p. 8-4 of RI Report). Receptors throughout the BCSA are exposed to COCs from these secondary sediment sources. Human health risks from these sediments are within the range of 10^{-4} to 10^{-6}. These sediment sources are located in waterways in UBC and MBC.

- Section 3: General Feasibility Study Approach - describes how the Phase 1 FS will incorporate information from the BCSA Candidate Technologies Memorandum (CTM, BCSA Group, 2010), the Development and Screening of Remedial Alternatives Memorandum (DSRAM, BCSA Group, 2015), and BCSA Group response to EPA comments on the DSRAM (BCSA Group, 2016) that have already been prepared pursuant to the AOC/SOW. This section also describes how the Phase 1 FS will follow the National Contingency Plan (NCP) and associated reference materials and guidance (EPA, 1991; EPA, 1999; and EPA, 2002), including agency guidance on conducting the detailed and comparative evaluations of remedial alternatives (EPA, 1988 and EPA, 2005).

- Section 4: Feasibility Study Report - describes the preparation and submittal of a draft FS Report to EPA for agency review, and revision and submittal of a final FS Report that responds to the EPA review comments on the draft report.

- Section 5: Schedule - presents an updated proposed RI/FS schedule.

- Section 6: References – provides a list of the references cited in the document.

SECTION 2

SCOPE OF FS EVALUATION FOR PHASE 1 REMEDIAL ACTION

As described in Section 1, EPA has specified that an adaptive approach is appropriate for the BCSA and that the first phase (Phase 1) of remedial action (1) will include control of waterway sediments in UBC and MBC; and (2) will addresses the marsh area of UPIC. The following narrative describes the extent of waterway areas in UBC[2] and MBC that will be included in the evaluation of source control remedial alternatives during the Phase 1 FS, as well as a brief summary of the factors considered in defining the area. The horizontal extent of the Phase 1 remedial action will be refined, as necessary and appropriate, in the FS Report and as additional data and information are considered during the Phase 1 remedial design.

The primary objectives of the Phase 1 interim remedial action are to:

1. Reduce exposure of human and ecological receptors through control of sources of COCs in (and to) the biologically active zone (BAZ) of sediment in the UBC, MBC, and UPIC waterways.

2. Reduce resuspension of COCs into the water column and migration of COCs from sediment in UBC, MBC, and UPIC waterways into adjacent marshes and downstream study segments (BCC and LBC).

3. Reduce exposure of human and ecological receptors to COCs in UPIC Marsh sediment.

4. Reduce uncertainties with regard to the response of the system to remedial actions to control movement of COCs and uncertainties related to exposures in the marshes through performance monitoring.

Success of the Phase 1 remedial action for the waterways requires effective control of COC migration in and to the BAZ of UBC and MBC waterway sediment for the following reasons:

- Ecological receptor exposure to COCs in the UBC and MBC waterways is driven by direct contact with sediment in the BAZ; intake of COCs that enter the food web as particulates resuspended to the water column from the fluff layer[3] (top ~0.5 cm of sediment) at the surface of the waterway sediment bed; and bioaccumulation and

[2] Note: For the purposes of the Phase 1 FS evaluation, the waterways in UPIC are included with UBC waterways.
[3] The fluff layer is a common element of estuarine sediment beds (Sanford 1992; Maa and Lee 2002; Small and Prahl 2004). It is a thin (~0.5 cm) unconsolidated fine sediment layer that resides on the surface of the waterway sediment bed. BCSA fluff materials have characteristically low density and are relatively easily resuspended from the surface of the waterway sediment bed by tidal action and common storm flows.

biomagnification of COCs across the food web. Refer to Appendix L of the RI Report for additional discussion of ecological exposures and risks.

- Human exposure, although infrequent, to COCs in the UBC and MBC waterways and recreational users and workers in these areas is directly related to COCs in the BAZ. The primary human exposure to COCs results from the ingestion of biota (e.g., fish, crab) that have accumulated COCs directly or indirectly from waterway BAZ sediment. Refer to Appendix M of the RI Report for additional discussion of human exposure and health risks.

- Routine resuspension of fluff layer particulates from the surface of waterway sediment to the water column is a primary mechanism for transport of waterway sediment COCs to surface water and, in turn, migration of COCs from more contaminated areas of the waterways in UBC and MBC to less contaminated waterway areas and to the marshes. Refer to Appendices E and G of the RI Report for additional discussion of the role of fluff layer resuspension on COC transport.

The area preliminarily identified for the evaluation of alternatives for the Phase 1 interim remedial action is presented in Figure 2-1. The identification of the Phase 1 area is based on the extensive characterization of the waterway and marsh sediment during the RI, as presented in Appendix F of the RI Report, including the following factors as the focus of the source control activity:

- This area of waterways in UBC and MBC has the most elevated COC concentrations in surface sediment compared to other waterways in the BCSA;

- Concentrations of COCs (Hg and PCBs) are more elevated in the BAZ of waterways than in the surface of the marshes;

- Surface COC concentrations in UPIC Marshes are higher elevated than other marshes and are attenuating much more slowly than in other marshes;

- COC concentrations in the identified area present elevated exposure risks relative to exposure levels elsewhere in the BCSA; and

- COCs in the waterway sediments in this area have a higher potential for transport into the overlying water column, and from there to other portions of the BCSA, including marshes and downstream waterways and therefore can act as a continuing source of elevated to COC concentrations to exposure points.

These factors are discussed further below and supported by analyses in the RI Report.

COC concentrations in waterway BAZ sediment decrease from north to south across the site. Review of the spatial distribution of mercury and PCBs (total Aroclors)[4] in waterway BAZ sediment shows that a breakpoint in concentration occurs at the lower end of MBC in the area upstream of the East Rutherford tide gate and the New Jersey Sports and Exhibition Authority outfall (Figure 2-2). Mercury and PCB concentrations in many of the BAZ sediment samples collected in UBC and in MBC upstream of this breakpoint are significantly elevated above the concentrations measured in BAZ sediment collected from elsewhere in the BCSA. Below the breakpoint location, mercury and PCB concentrations in BAZ sediment are not as significantly elevated and they approach or overlap with the range of concentrations in reference site BAZ sediment.

The location of the breakpoint also reflects the hydrodynamics, sediment transport and deposition characteristics of the BCSA. These processes were evaluated in detail during the RI and are described in Appendix G of the RI. The flow in the BCSA is dominated by the twice daily tidal exchange with the Hackensack River (Figure 2-3b). The water volume in BCC and LBC is nearly completely exchanged with tidal water daily; while MBC and UBC, which are more distant from the River, are exchanged less frequently, with water residence times of approximately 4 and 6 days, respectively (Figure 2-3b). The majority of the historical industry and sewage discharges to the BCSA were located in UBC and MBC and the highest concentrations of COCs associated with these sources are present in UBC and MBC sediment. Although COC concentrations in waterway sediment have undergone considerable recovery from historic maximums, mercury and PCB concentrations remain substantially elevated in BAZ sediment in UBC and much of MBC relative to BCC and LBC, as well as reference site conditions.

The breakpoint location in MBC also is consistent with the hydrology and relative influence of sediment sources within the system. More than 50 percent of the BCSA uplands watershed drains to UBC, and water velocities in UBC and upper portions of MBC are more frequently influenced by storm flow conditions than the lower reaches. As a result, uplands are estimated to supply a high percentage (over 75% on average) of the inorganic sediment to UBC (Figure 2-3c). BAZ sediment in UBC and MBC contains a greater proportion of coarse-grained particulates (fine sand) than the lower reaches (Figure 2-3d), reflecting both the higher velocities that occur in these areas during episodic storm flows and the shift in the dominant source of depositing sediments (Figure 2-3a). The Hackensack River becomes an increasingly dominant source of

[4] Mercury, methyl mercury, and PCBs are the primary COCs important to defining site risks (see the risk assessments in Appendices L and M of the RI Report). Mercury and PCB concentrations in BAZ sediment were the primary focus in establishing the extent of the waterway area to be considered in the Phase 1 FS evaluation of source control alternatives. Methyl mercury is generated *in situ* as a result of microbiological transformation of inorganic mercury. Other COCs (e.g., chromium) are also present in waterway sediment and are evaluated in the risk assessments. Compared to mercury and PCBs, these secondary COCs contribute less to site risks and their distribution in waterway BAZ sediment is similar to the primary COCs.

inorganic sediment downstream of UBC/MBC. The proximity of BCC and LBC to the Hackensack River is reflected in the source of sediment depositing in these areas, with approximately 90+ percent of the inorganic sediment deposited in these reaches estimated to originate in the Hackensack (Figure 2-3c).

The extent of the waterway area to be considered in the Phase 1 FS includes the entirety of the main channel in UBC and in MBC upstream of the breakpoint location, as well as a large portion of the UBC and MBC tributaries (Figure 2-1). Soft sediment with elevated concentrations of COCs compared to other areas in the BCSA will be the focus of the sediment control evaluation in the FS. This soft (relatively unconsolidated) sediment was deposited within the last 100 years and contains all of the site-related COCs, whereas the more consolidated underlying sediment was deposited prior to industrial activity in the 1900s in the BCSA. In addition, the surface soft sediment has a potential for redistribution to the BAZ, marshes, and other waterway areas, depending on the surface water velocity profiles overlying the sediment bed and fluvial geomorphology factors identified in the RI. These conditions will be evaluated in more detail in the FS.

Currently, it is anticipated that the tributaries included in the Phase 1 remedy waterway footprint will be the larger tributaries that both serve as the primary conveyances of water to and from the marshes during tidal exchanges and of storm flows from uplands to the main channel (Figure 2-1). These tributaries are characterized by relatively large channel cross-sections and areas where the soft sediment thickness is likely to be greater than 1 foot with relatively high COC concentrations and therefore are a potential continuing source of COCs to other areas. These factors will be considered further in the Phase 1 FS to ensure remedial action addresses elevated COC concentrations associated with the marsh tributaries, while minimizing physical disturbance of the marshes during the remedial action. The extent of the tributaries to be addressed under the Phase 1 remedial action will be refined during the FS and remedial design, as additional information and data are developed and evaluated in an adaptive management context.

The marsh areas in UPIC are included in the Phase 1 Remedy because this area has some of the highest surface concentrations of COCs (especially inorganic mercury) in the BCSA and a very slow rate of natural attenuation after completion of the PIC tide gate, which prevented sediment input from the tidal area since about 1967. The alternatives evaluation for this non-tidal and primarily freshwater marsh area (presuming continued operation & maintenance of the PIC tide gate) will take into account the location-specific conditions.

SECTION 3

GENERAL FEASIBILITY STUDY APPROACH

3.1 Overview

In accordance with the BCSA AOC and SOW, the FS process described in the original RI/FS Work Plan was designed to be conducted in a stepwise manner, involving development of the 2010 CTM as a first step, the 2015 DSRAM as a second step, and a comprehensive FS for the entire BCSA project area as a third and final step that would ultimately lead to an EPA ROD for the entire site. As described in Section 1 of this addendum, primarily because of the findings of the RI, the conceptual site model (CSM), and the nature of the remaining uncertainties related to natural recovery of the marshes, EPA has directed a phased approach to evaluating and implementing remedial alternatives for the BCSA. Phase 1 will focus on a source control remedial action for the UBC and MBC waterways, and a complementary separate but coordinated remedial action for the UPIC Marsh. Given the focus and interim nature of the Phase 1 remedial action, EPA indicated in its June 13, 2016 letter that the Phase 1 FS may be streamlined with respect to the selection and evaluation of remedial alternatives.

3.2 Description of Overall FS Process

Consistent with the stepwise approach described in the original RI/FS Work Plan, potential general response actions (GRAs) for the BCSA waterways and marshes were first identified in the 2010 CTM. GRAs that were considered at that time for both the waterways and marshes included: (1) no action/institutional controls; (2) monitored natural recovery (MNR); (3) thin-layer placement; (4) containment (capping); (5) removal; (6) consolidation and disposal; (7) in-situ treatment; and (8) ex-situ treatment.

In the 2015 DSRAM, the GRAs were modified for purposes of development and preliminary screening of remedial alternatives potentially applicable to future BCSA remedial actions. The GRAs provided in the DSRAM were:

- No action;
- Institutional controls (ICs);
- MNR;
- Enhanced MNR (EMNR), which was considered in the DSRAM to include the following technology options: thin-layer placement, thin-layer placement with amendments, and in-situ treatment (in-situ amendment addition);

- Containment (capping); and
- Removal.

Note that the CTM GRA "sediment consolidation and disposal" was not included as a separate GRA in the DSRAM, as it is considered a component of all potential removal alternatives. Both on-site consolidation and off-site disposal of removed sediment were retained as technology options for the removal alternatives. In addition, ex-situ treatment (e.g., dewatering and stabilization) was not included as a separate GRA because it was viewed as a technology option to treat removed sediment to make it suitable for consolidation and/or disposal.

MNR will not be considered as a Phase 1 GRA because MNR cannot achieve the source control objective of Phase 1 within a reasonable timetable. However, following Phase 1, MNR will be included in the alternatives evaluation based on the RI and subsequent performance monitoring data. Additional discussion of MNR as part of the future alternatives evaluation will be included in a post-Phase 1 FS.

From the refined list of GRAs, ten remedial alternatives were developed in the DSRAM for further screening in that document. The remedial alternatives were screened in the DSRAM based on a qualitative evaluation of their expected short- and long-term effectiveness, implementability, and cost. The qualitative criteria for effectiveness ranged from highly effective to not effective, those for implementability ranged from highly implementable to not implementable, and those for cost ranged from very low cost to very high cost.

The DSRAM alternatives screening effort eliminated only one alternative, Full-Depth Removal without Backfill, for both waterways and marshes. This alternative was not retained for the waterways because removal without backfilling would result in significant hydrodynamic changes to the waterways and likely loss of support for the marsh banks, potentially destabilizing the channels and marsh banks. For marshes, full-depth removal without backfill would result in the loss of marsh habitat and the creation of new open water areas. Marsh restoration is not possible without backfilling to appropriate grades, consistent with the DSRAM.

The DSRAM presented a set of alternatives that, individually or in combination, were potentially applicable to the full range of conditions within the BCSA. However, it was submitted to EPA well before the completion of the BCSA RI and before the BCSA Group receipt of the June 13, 2016 letter from EPA endorsing a multi-phase, adaptive management approach to site remediation. The range of remedial alternatives to be evaluated in the Phase 1 FS will be more focused than the range considered in the DSRAM. Specifically, consistent with the shift in risk management approach directed by EPA June 2016 letter, the Phase 1 FS will address remedial alternatives for the UBC and MBC waterways to reduce the exposure to COCs mobile BAZ sediments, and reduce resuspension and migration of the COCs from those sediments to the

marshes and downstream waterways. The Phase 1 FS also will address alternatives to reduce exposure of human and ecological receptors to COCs in the UPIC Marsh sediment.

The Phase 1 FS process will follow the process described in the original RI/FS Work Plan, which includes satisfying the requirements of the BCSA AOC and SOW, National Contingency Plan (NCP) and CERCLA requirements, and applicable EPA guidelines, including the EPA Office of Emergency Response (OSWER) RI/FS guidance (EPA, 1988) and EPA contaminated sediment remediation guidance (EPA, 2005). The Phase 1 FS process will involve the development of remedial action objectives (RAOs), the assembly of remedial alternatives for the UBC and MBC waterways and for the UPIC Marsh, the detailed and comparative evaluations of these alternatives, preparation of an FS Report, preliminary scoping of a Marsh Demonstration Project, and scoping of a Performance Measures Monitoring Plan.

3.3 Establishment of Remedial Action Objectives

EPA's contaminated sediment guidance (EPA, 2005) states that the RAOs for a site are intended to provide a general description of what a remedial action is expected to accomplish, and thereby help to focus the development of remedial alternatives in the FS. RAOs are typically developed considering the exposure pathways described in the site CSM. The CSM presented in the RI report describes how surface sediments in the UBC waterway and a significant portion of the MBC waterway contain COCs at concentrations that are significantly higher than in the BCC and LBC. These COCs can move into surface water through resuspension of particulates from a thin (~ 0.5 cm) fluff layer of unconsolidated material on the surface of the soft sediment bed during flood and ebb tides and somewhat greater depths during episodic storm events. Most BCSA COCs are strongly associated with this particulate matter, which provides a pathway for introduction of the COCs into the detritus-based food web. Resuspended particulates in the UBC/MBC waterways can also be carried into the marshes or to downstream waterways due to tidal action and storm flows, thereby providing a continuing flux of COCs to these areas and slowing the progress of natural recovery.

Draft RAOs for the BCSA site were provided in the 2015 DSRAM. Given the stage of the RI when the DSRAM was developed, the RAOs at that time were general and meant to apply to the range of conditions at the site. In a February 22, 2016 letter from Douglas J. Tomchuk, EPA Remedial Program Manager for the BCSA site, to Peter Brussock, Project Coordinator for the BCSA Group, EPA provided comments on the DSRAM and indicated that new RAOs would be drafted "to reflect the scope and implementation approach during our discussions of a phased or adaptive management approach."

In response to EPA's comments on the RAOs in the DSRAM comments, the BCSA Group prepared substantially revised RAOs for the Phase 1 interim remedial action and has included them in the response to the DSRAM comments. These RAOs were developed with some preliminary input from EPA and upon EPA review and acceptance will be included in the FS

process to select and evaluate remedial alternatives for both the UBC and MBC waterways and the UPIC Marsh. Related performance monitoring measures will also be developed as part of the FS and remedial design process.

3.4 Assemble and Document Alternatives

For the Phase 1 FS, the GRAs and remedial alternatives considered in the DSRAM will be refined to focus on waterway sediment (secondary source) control for the UBC and MBC waterways. These should reduce the exposure to COCs in BAZ sediments and reduce resuspension and migration of the COCs from those sediments to the marshes and downstream waterways. The Phase 1 FS also will include alternatives to reduce exposure of human and ecological receptors to COCs in the UPIC Marsh sediment. Each developed alternative will be described in detail in the FS Report.

The Phase 1 FS will consider capping as well as a range of sediment removal depths as source control alternatives for the waterways, with these alternatives incorporating backfilling of the removal areas with materials designed to meet project objectives. The evaluation will also include the statutory no action alternative.

Based on the goal of reducing exposure of human and ecological receptors to COCs in UPIC Marsh surface sediment, the areal and vertical extent of contaminated sediment in the marsh, and the site CSM, it is anticipated that the remedial alternatives that will be evaluated for the UPIC Marsh will include thin-layer cover (with or without amendments), removal and backfilling alternatives. The evaluation will also include the statutory no action alternative.

3.5 Detailed and Comparative Analysis of Remedial Alternatives

For the Phase I FS, the framework for the evaluation of remedial alternatives will be EPA's 1988 RI/FS guidance as supplemented by EPA's 2005 contaminated sediment remediation guidance. The evaluation will involve assessing each remedial alternative against the seven CERCLA threshold and balancing criteria, namely:

- Overall protection of human health and the environment (threshold);
- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) (threshold);
- Long-term effectiveness and permanence (balancing);
- Reduction of toxicity, mobility, or volume (balancing);
- Short-term effectiveness (balancing),

- Implementability (balancing); and
- Cost (balancing).

EPA will consider the two CERCLA modifying criteria, State (or support agency) acceptance and community acceptance, after State comments are received on the FS Report and after public comments are received on the Proposed Plan.

The detailed evaluation of alternatives will be presented in a set of tables that assess each of the remedial alternatives against each of the threshold and balancing CERCLA criteria. A summary table will also be presented that illustrates the degree to which each alternative satisfies each criterion.

The comparative analysis of alternatives will involve comparisons of the degree to which the various remedial alternatives meet each specific CERCLA criterion. The 2005 EPA contaminated sediment remediation guidance suggests that comparative analyses address the net risk reduction associated with each alternative. However, as Phase 1 focuses on source control in UBC and MBC waterways and the marsh in the non-tidal UPIC area, the comparative analysis will focus more on achievement of RAOs as opposed to quantitative evaluation of risk reduction. Finally, the comparative analysis of alternatives will address considerations related to green and sustainable remediation (GSR) principles and projects that may be proposed by NJDEP in furtherance of the Rebuild by Design (RBD) project to mitigate flooding in the area, as appropriate.

In accordance with the AOC SOW, within thirty (30) days of the Respondents' notification to EPA of the completion of the detailed analysis, Respondents shall, upon EPA's request, make a presentation to EPA and the State summarizing the detailed analysis of remedial alternatives.

SECTION 4

FEASIBILITY STUDY REPORT

4.1 Prepare Draft Feasibility Study Report

The BCSA Group will submit a draft FS Report for the Phase 1 source control remedial action to EPA for review, comment, and approval. The report will present the detailed and comparative analysis of alternatives with respect to the CERCLA threshold, balancing criteria as required by the NCP. The report will be prepared in accordance with the EPA RI/FS Guidance (EPA, 1988) and the Contaminated Sediment Remediation Guidance (EPA, 2005). The draft report will:

- Summarize the multi-phase, adaptive approach to remediating the BCSA, and the rationale and scope of Phase 1.
- Describe the Phase 1 FS objectives.
- Present the RAOs.
- Briefly summarize the CTM and DSRAM findings.
- Describe the remedial alternatives evaluated.
- Provide FS level cost estimates (+50/-30) for each considered alternative.
- Present the detailed analysis of remedial alternatives, with each alternative evaluated against the seven CERCLA threshold and balancing criteria.
- Present the comparative analysis of alternatives.
- Include appendices containing detailed evaluations and analyses, as appropriate, to support the FS main report.

In addition, a separate appendix will preliminarily describe the Marsh Demonstration Project, the purpose of which will be to evaluate the physical, chemical, and/or biological responses of a selected tidal marsh area to application of one or more marsh remediation technology options on a scale larger than the pilot studies completed to date. As discussed with EPA earlier in 2016, the project is warranted to reduce uncertainty as to the potential benefits of remedial actions in the marshes following the waterway sediment control actions. The pilot study area will likely be in UBC and will be initiated after completion of sediment-related remedial actions in the vicinity of the demonstration project area.

4.2 Draft Feasibility Study Report Presentation

The BCSA Group will prepare and present a summary of the draft FS Report to EPA and discuss the agency's preliminary comments on the document. As specified in the AOC SOW, this meeting will tentatively be held within 14 days of submitting the draft FS Report, unless extended by EPA.

4.3 Respond to EPA Comments on the Draft FS Report

To the extent that EPA provides written comments to the draft FS Report the Group will respond to the comments and submit a formal response to comments letter.

4.4 Final Feasibility Study Report

Once EPA's comments have been addressed by the BCSA Group to EPA's satisfaction, the final FS report will be submitted to the agency.

SECTION 5

SCHEDULE

Figure 5-1 provides an updated draft schedule for the RI/FS that reflects updates to the Remedial Investigation and Risk Assessment Reporting and Review Schedule and identifies the primary milestones related to the FS detailed alternatives evaluation and reporting process. Overall, recognizing the focus of the FS in support of the Phase I ROD, the schedule was revised to accelerate the detailed alternatives analysis and FS preparation process in parallel with the completion of the RI, including the baseline risk assessments. This schedule projects submittal of the draft FS Report in early 2017. The timing of activities after submission of the draft FS is subject to the timing of future interaction between the BCSA Group and EPA.

SECTION 6

REFERENCES

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